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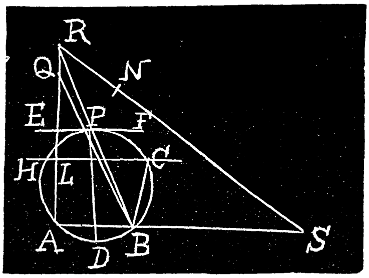

ment APB containing the given angle. Draw the diameter PD perpendicular to AB. Also draw AQ perpendicular to AB. Draw BP meeting AQ in Q. With B as a center, and a radius equal to p, describe an arc cutting AQ produced in R. With R as a center, and a radius equal to $p+AQ$, describe an arc cutting AB produced in S. On SR measure off $SN=$to SA. Then RN $=$the altitude. Take $AL=RN$, and draw HLC parallel to AB, cutting the circle in C. Draw AC, BC. Then ACB is the required triangle. For let x, y, z be the sides BC, AC, and the altitude. Then $xy\sin C=az$, $x+y+z=p$, $a^2=x^2+y^2-2xy\cos C$.

$\therefore a^2+2xy(1+\cos A)=(p-z)^2$. $\therefore z^2-2(p+a\cot\frac{1}{2}C)=a^2-p^2$.

$\therefore z=p+a\cot\frac{1}{2}C-\sqrt{[(p+a\cot\frac{1}{2}C)^2-(p^2-a^2)]}$.

$\angle AQB=\frac{1}{2}C$, $AQ=a\cot\frac{1}{2}C$, $RS=p+a\cot\frac{1}{2}C$, $AR=\sqrt{(p^2-a^2)}$, $AS=\sqrt{[(p+a\cot\frac{1}{2}C)^2-(p^2-a^2)]}$.

$\therefore RN=z$. $\therefore$The triangle ACB contains all the required parts.

Also solved by J. Scheffer.

353. Proposed by L. H. McDONALD, M. A., Ph. D., Sometimes Tutor at Cambridge, Jersey City, N. J.

In a given circle place two chords which shall be in a given ratio and also a given distance apart.

Solution by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa.

Let the ratio $m:n$ to distance apart$=d$; the radius of the given circle $=r$; u, v the distances of the chords from the center.

Then $2\sqrt{(r^2-u^2)}$, $2\sqrt{(r^2-v^2)}$ are the lengths of the chords.

$\therefore m\sqrt{(r^2-v^2)}=n\sqrt{(r^2-u^2)}$, or $(m^2-n^2)r^2=m^2v^2-n^2u^2$, and $u+v=d$.

$$\therefore u=\frac{m^2d-\sqrt{[r^2(m^2-n^2)^2+m^2n^2d^2]}}{m^2-n^2},$$

$$v=\frac{\sqrt{[r^2(m^2-n^2)^2+m^2n^2d^2]}-n^2d}{m^2-n^2}.$$

Hence, if $AB=d$, take $AC=u$, $CB=v$, and with C as center and radius r describe a circle, through A and B perpendicular to AB draw lines intersecting this circle. The chords of the circle formed by these lines are the chords required.

Also solved by S. A. Corey.

354. Proposed by W. J. GREENSTREET, M. A., Marling School, Stroud, England.

Find the condition that triangles which are circumscribed to one of two confocal parabolas may be inscribed in the other.

Solution by G. B. M. ZERR. A. M., Ph. D., Philadelphia, Pa.

Let $y^2=4a(x+a)$, $(y\cos\beta+x\sin\beta)^2=4A(x\cos\beta-y\sin\beta+A)$ be the confocal parabolas.

(1) $y^2-4ax-4a^2=0$.
(2) $y^2\cos^2\beta+x^2\sin^2\beta+2xy\sin\beta\cos\beta-4Ax\cos\beta+4Ay\sin\beta-4A^2=0$.

Calculating the invariants for (1) and (2) we get

$$\triangle=-4a^2,\quad \Theta=-4a(a+2A\cos\beta),$$
$$\Theta'=-4A(A+2a\cos\beta),\quad \triangle'=-4A^2.$$

The condition is given by $\Theta^2=4\triangle\Theta'$.
$\therefore 16a^2(a+2A\cos\beta)^2=16a^2A(A+2a\cos\beta)$.
$\therefore a^2/A^2+2(a/A)\cos\beta+4\cos^2\beta=1$, $a/A=-\cos\beta\pm\surd(1-3\cos^2\beta)$.
$\therefore \cos\beta>1/\surd3$.
$\therefore \beta$ lies between 54° 44′ and 125° 16′, and also between 234° 44′ and 305° 16′.
If $\beta=\frac{1}{3}\pi$, $a=\infty A$ or $-A$.
If $\beta=\frac{1}{2}\pi$, $a=A$ or $-A$.
If $\beta=\frac{2}{3}\pi$, $a=A$ or ∞A, etc.

CALCULUS.

282. Proposed by S. G. BARTON, Ph. D., Clarkson School of Technology, Potsdam, N. Y.

A rectangular beam of length l and width w is taken horizontally from a hall of width b into a corridor at right angles to the hall. Find the width of the smallest corridor into which it can be taken.

Solution by G. B. M. ZERR, A. M., Ph. D., Philadelphia, Pa., and J. M. ARNOLD, Crompton, R. I.

Let $ABCD$ be the beam, the corner A against the hall wall, the corner B against the corrider wall; the point P of the beam against the corner of of meeting of hall and corrider.

Let $AB=l$, $BC=w$, x=width of corrider, PQ the portion of the width the corrider under the beam, QR the remainder of the width.

Then $PQ+QR=x$, $AQ+QB=l$, $ER=b$, $\angle BAE=\theta$. Then $PQ=w\operatorname{cosec}\theta$, $AQ=b\operatorname{cosec}\theta$, $QR=(l-b\operatorname{cosec}\theta)\cos\theta$.
$\therefore x=w\operatorname{cosec}\theta+(l-b\operatorname{cosec}\theta)\cos\theta$...(1).
Differentiating (1) we get, $w\operatorname{cosec}\theta\cot\theta+l\sin\theta=b\operatorname{cosec}^2\theta$.
$\therefore w\cos\theta=b-l\sin^3\theta$...(2).
The value of θ from (2) in (1) gives the width x required.
(2) becomes $l^2\sin^6\theta-2bl\sin^3\theta+w^2\sin^2\theta+b^2-w^2=0$.

Also solved by J. E. Sanders and the Proposer.